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CHANGES IN YOUNG CHILDREN'S CLASSROOM BEHAVIOR AFTER A YEAR OF COMPUTER-ASSISTED INSTRUCTION: AN EXPLORATORY STUDY. RESEARCH MEMORANDUM.

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When assessing the influence of computer assisted instruction, attention should be given not only to rate and error of performance in the acquisition of content, but also to non-performance aspects of children's behavior. To this purpose, computer assisted instruction (CAI) was given to 45 first grade students for 35 minutes during each day of the school year, and their academic and social behaviors, as measured by 66 categories of a Behavior Survey Instrument, were compared to the behaviors of 27 other students who were teacher-taught (non-CAI). Data gathering was by point sampling; reliability of observation was achieved by two-man teams, independently judging the same behavior. Percents of agreement ranged from 60% to 98%. Between the beginning and the end of the school year, the social behavior scores for the CAI students decreased significantly while the corresponding scores for the non-CAI group significantly increased. This suggests that the individualized computer instruction made students less socially oriented while the unvarying group setting of the non-CAI students tended to increase their social skills. However, uncontrolled variance (e.g. the seven different classroom teachers involved) is an alternative hypothesis for the differences. The findings are interpreted as suggesting that CAI may reduce the expected positive relations among academic behavior, IQ, and achievement. (MJ)

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STANFORD CENTER FOR RESEARCH AND DEVELOPMENT IN TEACHING

Research Memorandum No. 31

CHANGES IN YOUNG CHILDREN'S CLASSROOM BEHAVIOR AFTER A YEAR OF COMPUTER-ASSISTED INSTRUCTION: AN EXPLORATORY STUDY.

by

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Changes in Young Children's Classroom Behavior After a Year of Computer-Assisted Instruction: An Exploratory Study

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Much attention has been given in recent literature to learning that takes place under programmed instruction (Lumsdaine, 1964). Computer assisted instruction, a form of programmed instruction, is still in its infancy; here too the preoccupation has been with rate and error of performance in the acuqisition of certain content. Learner variables that have been investigated usually consist of age, past experience in the content area, IQ and sex (Atkinson, 1968). There has, in addition, been considerable speculation that non-cognitive and motivational factors influence performance in learning situations (de Charms, R. & Carpenter, V., mimeograph; Wodtke, Mitzel & Brown, 1965), and a number of researchers have issued strong pleas for naturalistic study of these phenomena (National Conference on Needed Research in Mathematics Education, 1967).

Hilgard (1964) has proposed a number of characteristics of programmed instruction which distinguish it from more typical classroom instruction: its sedentary, nonsocial character, its reduction in the opportunity for problem solving and divergent thinking, its lack of opportunity for initiation of inquiry, and the possibility that because of these things there may be a progressive tendency toward conformity rather than diversification of talent. These notions and their implications for children's development have not been subjected as yet to careful study. Thus, we are led to ask the following question regarding computer assisted instruction (CAI): When computer assisted instruction, a form of programmed instruction, is introduced for part of the day into a normal school situation, can we expect this treatment to influence general classroom behavior? In asking this question, it is assumed that non-performance aspects of children's behavior are important variables to look at when assessing the influence of a new curriculum or instructional technique.

The present research was directed toward two issues which follow from the discussion above:

1. Are there changes in children's classroom behavior, broadly conceived (e.g., social, task oriented, motivational, satisfaction, problem solving, etc.) which, over time, may be attributed to a partial schedule of computer assisted instruction?

2. Are there differences in the relations between classroom behavior, achievement and IQ for children who received computer assisted instruction versus those who did not? And, did these differences change over time?

The design of the study involved Fall 1966 and Spring 1967 sampling of first-graders' classroom behavior on a number of dimensions. The CAI group of 45 children received approximately 35 minutes per day of CAI; half the group received Reading instruction and half Mathematics. These programs were under the direction of Patrick Suppes and Richard Atkinson(1967), and are described in the report cited. A non-CAI group of 27 children attended a comparable school; they received both Reading and Mathematics instruction in the classroom setting with a human teacher. Measures of achievement included progress on the computer, IQ and standard achievement tests in reading and arithmetic for the CAI group, reading achievement for the non-CAI. All the achievement measures were taken in the Spring.

METHOD

First graders in the classroom setting engage in numerous types of behavior, some work and achievement oriented, some socially motivated. First grade teachers vary in their attempts to increase the former and reduce the latter, saying: "A classroom is a place for work" and/or "A classroom is a social place in which work and social relationships go along together." Young children usually adapt (fairly well) to the expectations of the school in these regards.

A Behavior Survey Instrument was designed to reflect, through systematic observations of behavior, the possibilities children have in

responding to the classroom environment. In its original form, the Behavior Survey Instrument included 120 possible categories of behavior. Because of low frequencies of occurrence, a number of behavior categories were dropped from the study, leaving 66 categories which were included in the analyses.* Based on the major areas of the Behavior Survey Instrument, the 66 variables were combined to form 18 scores ranging from a single behavior (e.g., achievement motivation) to a weighted combination of several behaviors (e.g., social = social work + social motivation + child and teacher interaction + child initiates interaction with teacher). The resulting 18 variables (9 composite scores taken at two points in time, Fall and Spring) were subjected to correlational and factor analysis.

Data Gathering. The method used for data gathering was point-sampling; the observer focused on a single child at a time, categorized his behavior in each of the areas of the Behavior Survey Instrument, then moved on to observe another child. Since each categorization was to represent a momentary sample of the child's behavior, the behaviors perforce had to be relatively simple. The observer had to derive his cues from the child's posture, facial expression, activity, or speech. The 7 areas of the Behavior Survey Instrument, briefly described, were as follows:

(a) Tendency to pay attention to a school activity; orientation to task; persistence

(b) Satisfaction inclassroom activities

(c) Quality of motivation toward task performance

(d) Dependency on the teacher

(e) Tendency toward social interaction with other children

(f) Cognitive development in several areas; cognitive style, curiosity, flexibility of mental set, etc.

(g) General mobility level

Reliability of observation for these categories of behavior was achieved by independent judgments of 2-man teams observing the same

* For a more complete description of the Behavior Survey Instrument, including relevant reliability and validity data, see Katz, L., Peters, D., and Stein, N. (1968). Copies of the instrument are available on request from the Stanford Center for Research and Development in Teaching, Stanford University, 770 Welch Road, Suite 250.

behavior simultaneously. This reliability check was done with two different sets of observers. Percents of agreement on categorization of behavior ranged from 60% to 98%.

Subjects. Ss were 45 first graders who received CAI instruction beginning about November; 27 first graders who received modern classroom instruction in mathematics and reading (non-CAI). Children were randomly selected to represent half the population in each of seven first grade classrooms. The children in the two groups were from highly comparable SES areas; about 77% from minority groups, with a mean IQ of about 90. The majority could probably be classified as children of the poor.

Behavior Data and their Implications. For the Fall and Spring data used here, 20 rounds (separate samplings) of each child's behavior were obtained at each time period. These were separated in immediate time by having the observer sample the behavior of each of his 8 to 14 children (within one classroom) before returning to the first child of the sample. An attempt was made to make the behavior sampling representative of the school classroom day; however, the degree of representation may not have been uniform from observer to observer. Furthermore, each observer made his observations within one classroom; hence there is uncontrolled or extraneous variance ascribable to possible differences (in spite of observer reliability) between classrooms and observer's choice of observation time. The data reported are based on single observer recording, rather than simultaneous observation and recording.

The data were collected in December for the Fall sampling and in May for the Spring. The observer who had made the Fall sampling returned to the same classroom for the Spring sampling; however, his Fall data were not made available to him in the Spring. Observers were aware of which children were and were not receiving CAI instruction, but group hypotheses as to possible effects of CAI were not formulated until after the observations were made.

A further source of uncontrolled variance is the individual teaching style of the classroom teachers responsible for the four CAI classrooms (two each for the math and reading CAI groups) and three non-CAI

classrooms. Since the school day consisted of approximately five hours, of which 35 minutes was taken for CAI instruction, much remained for the individual teacher's discretion as to how the remaining time was spent. In addition, teachers for the CAI group received printouts regularly from their students on CAI progress. They were encouraged to utilize these to improve their classroom teaching; no doubt each teacher did so in a somewhat unique way. The non-CAI teachers were aware of the "comparison" features of the study and were, perhaps, for this and other reasons on their mettle to provide excellent teaching to their students.

These sources of error we are forced to accept in this naturalistic study. Numbers of subjects, teachers, classrooms, and schools, are small and the results should be examined in the light of these limitations. The data resulting from the Behavior Survey of children are of "package" type; four classrooms and teachers with children receiving CAI instruction for 35 minutes of the school day (but probably varying in many respects during the remaining time), three classrooms receiving no CAI (also varying in numerous respects). Such sources of variance can only reduce the precision of the major comparisons between CAI and non-CAI; as will be seen, some of these are nonsignificant, perhaps due to inadequacies of the naturalistic design. Furthermore, it cannot be concluded with certainty that significant differences resulted from real differences in the treatments or from unavoidable design problems. Such results should therefore be interpreted with proper caution.

RESULTS

The results of the study are presented as follows. First, the Behavior Factor scores are described. Second, differences in stability of behavior over time for CAI versus non-CAI, CAI Math versus Reading groups are presented. Third, mean differences between groups on the Behavior Factors are presented. Fourth, comparisons of Fall Behavior correlations with ability and achievement measures for CAI versus non-CAI, and CAI Math versus CAI Reading are attempted. Finally, Spring Behavior correlations with ability and achievement are presented for each group.

1. Conversion to Behavior Factor Scores

On the basis of a correlational and intuitive analysis, it was hypothesized that the variables included in the Behavior Survey could be grouped according to whether they measured chiefly academically directed or socially directed behavior. To test the hypothesis that two main factors could be defined, a principal components analysis was performed, using the total group of 72 subjects, on nine behavioral measures taken once in December and once in May. A varimax rotation of eight factors having eigenvalues greater than 1.00 revealed four factors, accounting for 54% of the total variance, which were judged to be of prime relevance in this study. These were labelled:

Factor 1: Academic Behavior, Spring
Factor 2: Social Behavior, Spring
Factor 3: Academic Behavior, Fall
Factor 4: Social Behavior, Fall

The variables having high loadings on the Academic behavior factors were cognitive behavior, task orientation, satisfaction and achievement motivation. Social motivation and a composite variable, Social "total," had the highest loadings on the two social behavior factors. The loadings are shown in Table 1.

Insert Table 1 About Here

The results of the factor analysis, while consistent with the hypothesized grouping of behavior variables, suggested that the Fall Academic and Social measures were essentially unrelated to the corresponding Spring variables, since four rather than two factors emerged from the factor analysis.

Three interpretations of this result are possible: (1) that different characteristics of children were being measured at the different time periods, i.e., the instrument was unreliable; (2) that the instrument was reliable, but that children's behavior was unstable over time during the first grade; or (3) that the sub-groups of children behaved in systematically different ways depending upon the treatment they received,

and that the differences were concealed when all 72 Ss were considered as one group. In view of the relatively high inter-observer reliability of the behavioral measures and because the same raters were used in Fall and Spring periods, it was concluded that the instrument was probably reliable. The fact that the hypothesized factor structure was confirmed lends further support to this conclusion. Thus, the first interpretation was not considered to be reasonable. The other possible explanations for independent factors were investigated in the data analyses.

In order to investigate the remaining explanations, we explored the relationships among behavior (Social and Academic), time of year, treatment (CAI and non-CAI), and achievement (mathematics and reading).

For purposes of analysis, the behavior measures were transformed to standard scores $z = \frac{X - \bar{X}}{Sd}$ and linearly combined to produce scores for each subject on each of the four main factors (N = 72). Weights used in the linear combinations were proportional to the factor loadings of the behaviors (see Appendix).

2. Stability of Behavior Factors by Treatment

A correlational analysis was carried out to determine if children who received CAI instruction differed from non-CAI children in the stability of their classroom behavior from Fall to Spring. It was expected that the CAI children would be less stable because of differential effects of CAI on children with different characteristics. The data in Table 2 reveal that the non-CAI children are highly stable (r = .65) in their Academic behavior but relatively unstable in Social behavior.

Insert Table 2 About Here

CAI children are not very stable in either Academic or Social behavior, but tend to be more stable in Social behavior (.36) than non-CAI children (.20). Generally speaking then, our expectation that CAI children would be less stable in their behavior than non-CAI children was supported. The two CAI groups--Reading and Math--show differential stability on Academic and Social behavior. This is provocative but may

be due to small samples.

3. Mean Differences in Behavior Factor Scores

To see if there were significant differences between groups in the amount of Social and Academic Behavior, as distinct from its stability over time, an analysis of variance was performed on each of the four factors. The data were analyzed for sex as well as for treatment differences. The results of this analysis are shown in Table 3.

Insert Table 3 About Here

For the Academic behavior factors, no differences on the basis of sex were found; this was true in the Fall and in the Spring. CAI children exhibited slightly greater amounts of Academic behavior during the Spring sampling than non-CAI children, but the difference was not significant. In Social behavior significant differences were discovered between CAI and non-CAI children: In the Fall, CAI children were significantly ($<.05$) higher on the Social factor than non-CAI children. For the Spring observations, the difference was reversed; the non-CAI children were significantly higher ($<.05$) on the Social factor than CAI children. This is a suggestive finding, and one which could conceivably be attributed at least in part to the effects of the CAI treatment. Regression toward the mean might possibly have been operating, but the change was considered too great to be attributed to regression effects alone. No sex differences were found in Social or Academic behavior.

4. Behavior Factor Scores as Related to Achievement

In this stage of the data analysis, we were interested in behavior as it relates to achievement. Ideally, we would hope to be able to observe a child's behavior in the classroom, and from these observations recommend the best curriculum or treatment for him. This goal has not been achieved in the present study; but we have found some provocative relationships among behavior, ability, and achievement which suggest the effects that different treatments may have on achievement. When measures for the CAI Math and Reading groups were examined separately, different results appeared.

Is behavior in the Fall a good predictor of Spring achievement?

Since our only common achievement measure for CAI and non-CAI groups was the California Reading Achievement Test, the results are somewhat skimpy. There were no significant correlations of Fall behavior with the single achievement measure available for all children.

Insert Table 4 About Here

This was as true for CAI as for non-CAI children, for Social as well as for Academic behavior. It should be noted that the findings of this analysis need not be interpreted as conclusive evidence that there is no relation between behavior and achievement. What we learned is that the behavior reflected in our Fall factors is not a good predictor of reading achievement.

The relations among Spring Academic behavior, ability and achievement were the next object of our inquiry. Normally, we expect IQ and achievement to be highly correlated and task-oriented behavior to relate positively to both (Sears, 1963).

Spring behavior had reasonably strong correlations with achievement in the CAI children, these correlations being positive with Academic behavior, negative with Social behavior. Directions of the correlations are generally the same in the Fall and Spring, but reach significance only in the Spring (Table 4). Thus, we conclude that within the CAI group there is a progressive strengthening over the year of the relation between behavior and achievement: those behaving in a task-oriented, achievement motivated fashion achieve increasingly better on tests and on computer progress, while those low in this behavior do not achieve as well. As pointed out earlier, the comparison with non-CAI children is not very convincing, but insofar as there are data (reading achievement and reading level) the increasingly strong behavior/achievement relationship does not appear in the non-CAI group.

5. CAI Math versus Reading

Are the correlations among ability, behavior and achievement different for the CAI Math versus Reading group? The results indicate some differences which may be attributed to whether the child was receiving

CAI instruction in math or in reading (see Table 5).

Reading Group

Fall Social behavior is correlated -.50 (<.01) with computer progress for the Reading group, -.33 (NS) for the Math group. Fall Social behavior is thus a reasonably good predictor of computer progress for children receiving CAI Reading instruction. No other correlations are significant for Fall behavior.

Insert Table 5 About Here

With regard to Spring behavior as it relates to ability and achievement, the following results were found. IQ and achievement measures in Reading are indifferently related to Academic behavior, but there is a significant positive correlation between that behavior and Math achievement (the non-CAI subject for this group). For Social behavior all correlations are negative, again most strongly with achievement in the non-CAI subjects.

Table 6 presents the same results for Academic behavior with IQ partialled out. The correlations between behavior and achievement in Math remain significant, but remain insignificant for Reading achievement. Thus, there are significant relations between behavior and achievement in the non-CAI subject, even with IQ partialled out, but no relation between Academic behavior and achievement in the CAI subject.

Insert Table 6 About Here

Math Group

Academic behavior is strongly related to IQ at the Spring testing in the group receiving Math CAI, i.e., the brighter children show more Academic behavior. This strong positive relationship between Academic behavior and achievement holds through each of the measures as expected, but drops to insignificance when the positive relation between IQ and Academic behavior (.71) is partialled out. The single exception, in which the relation between Academic behavior and achievement remains fairly high (.34) with IQ taken out, is in the teacher's judgment of the

child's reading level (see Table 6), a non-CAI subject. Possibly "behavior" entered more into this subjective judgment than it did into test or computer scores. The Math group's results are dominated by the large (.71) correlation between IQ and Academic behavior; the correlation for Reading CAI children was .29.

Thus, although not as consistent as the CAI Reading correlations, the Math group tends to confirm the finding that CAI reduces the expected correlation between Academic behavior and achievement in the subject in which CAI instruction was given. The correlation between Academic behavior and achievement in the non computer assisted subject matter area tends to hold up even after IQ has been partialled out.

DISCUSSION

In answer to the initially posed first question: Are there changes in children's general classroom behavior over a year which may tentatively be attributed to a partial schedule of computer assisted instruction? The answer is yes; relative to their non-CAI counterparts, CAI children increased in so called "Academic" behavior and decreased significantly in "Social" types of behavior. Since children receiving normal classroom teacher instruction showed reverse effects, the change does not appear to result only from the effect of six months exposure to first grade, though it must be recognized that the seven classroom teachers (four CAI, three non-CAI) may have exerted influence on this change independent of the computer variables.

The non-CAI children, accustomed to a whole day of group oriented, teacher-led instruction, perhaps developed adaptive patterns of social interaction over the year. One might speculate that the individualized, chiefly independent work on the computer reduced the development of social behavior and motivation, which appears more strongly in the classroom behavior of the non-CAI children.

The contrast between CAI and non-CAI groups in socially oriented behavior suggests that habits developed in the non-social, individualized sessions with the computer have tended to influence the CAI children to depend less on the human teacher and their peers for reinforcement,

to be motivated less by friendly (or hostile) social interactions and more by achievement vis a vis the task of the moment.

On the second question, regarding the relation of behavior to achievement in CAI versus non-CAI, it appears that CAI reduces the expected relation between behavior and achievement. There is a suggestion that this washing out of positive relationships is more pronounced in the subject matter for which CAI instruction was provided. Since the chief feature of CAI is its individualization of instruction, this result, although tentative, is sufficiently provocative to warrant further study. It may seem, for example, that for children who do not fit the stereotype of the academically oriented student, the CAI treatment allows for different responses to instruction without the usual debilitating effects on achievement.

It should be noted, however, that there were somewhat different results for CAI Reading as opposed to CAI Math children. The correlations for the CAI Reading group, for example, were more consistent than the CAI Math correlations; e.g., insignificant correlations between behavior and achievement in reading as well as significant correlations (even with IQ partialled out) between behavior and achievement in math were found for CAI Reading children. Although correlations for the Math CAI group tended to be in the same directions, they were often not significant. Our conclusions, therefore, were more solidly based on the results from the CAI Reading than the CAI Math treatment. According to the originators of the two CAI curricula there were differences in the programs which may have influenced the results.

Both CAI Reading and CAI Math groups spent the same amount of time in the CAU laboratory, but the CAI Math children were only at the terminals about two-thirds of the time they were in the building; the CAI Reading children were at the terminals virtually full time (Atkinson, R. C., 1968b). In addition, previous studies have indicated that it is extremely difficult to overcome the relation between IQ and math achievement in the first grade while no body of literature indicates the same is true for reading achievement and IQ (Suppes, P., 1968). A third difference between treatments is that teachers supplemented CAI instruction in Reading with classroom instruction, while Math was

taught exclusively by CAI.

These differences between treatments, as well as other limitations on the data previously mentioned, cause us to reiterate our caution in interpreting the results of the present study. They are, at best, guides to hypotheses for future research.

SUMMARY

The present study aimed to investigate possible effects of a partial treatment of computer assisted instruction on the classroom behavior of first grade children by comparing them with a group who received normal teacher-led instruction. A Behavior Survey Instrument was developed to permit observation and recording of children's responses to the classroom environment. Preliminary analyses of the Behavior Survey Instrument yielded 18 composite scores (9 categories of behavior at two points in time). These 18 variables were subjected to a factor analysis to test the hypothesis that the behaviors would yield two main factors, an Academic and a Social behavior cluster. However, four independent factors (Academic and Social behavior at each of two points in time) were defined. The subsequent data analysis used Ss scores on the four factors as dependent, independent and correlational variables. Despite independence of the four factors for the whole sample of children (N = 72), subgroup analyses revealed systematic differences between groups.

1. Stability. It was found, for example, that CAI children were less stable in Academic behavior than non-CAI children, while non-CAI children were slightly less stable than CAI children in Social behavior.

2. Mean Score Differences. It was also found that CAI children exhibited a greater amount of Social behavior during theFall sampling than non-CAI children, while the opposite was true in the Spring; there were no significant differences in Academic behavior, while non-CAI children showed a slight decrease between the Fall and Spring behavior samplings.

3. Behavior, IQ and Achievement. A correlational analysis of the relations between behavior factor scores, measures of achievement and IQ

yielded the following results. Neither Social, Fall nor Academic, Fall behavior showed a consistent pattern of correlations with ability or achievement. Spring Academic behavior, however, correlated positively and significantly with achievement and IQ measures, while Spring Social behavior correlated negatively with these measures. Since few measures of achievement and IQ were available for the non-CAI Ss, meaningful comparisons were not possible. Comparisons between the two CAI treatments, however, were carried out.

4. CAI Reading versus CAI Math. The results indicated that Fall Social behavior was a reasonably good predictor of the progress a child would make in the CAI Reading curriculum for the CAI Reading group. This was not as true for the Math CAI children in Math.

In the CAI Reading group, a significant correlation was found between Academic behavior and achievement in the non-CAI subject; this correlation remained significant even after IQ was partialled out.

For the Math CAI children, Academic behavior (Spring) was strongly related to IQ ($.71, < .01$). Strong positive correlations between behavior and achievement were diminished to nonsignificance when the correlation between IQ and Academic behavior was partialled out. The correlation did hold up in one case, Reading Level, which was a non-CAI treatment achievement measure.

The findings were interpreted as suggestive of a possible reduction in the expected positive relations among academic behavior, IQ and achievement in the curriculum in which a child received CAI instruction. Also presented was a discussion of the results in terms of questions raised in the beginning of the study.

REFERENCES

Atkinson, Richard C. Computerized instruction and the learning process. American Psychologist, 1968, 23 (4), 225-239.

Atkinson, R. C. Personal communication. 1968b.

deCharms, R. & Carpenter, Virginia. Measuring motivation in culturally disadvantaged children. Mimeo. Box 1183, Washington University, St. Louis, Missouri, 63130.

Hilgard, E. R. Issues within learning theory and programmed learning. Psychology in the schools, 1964, 1, 129-140.

Katz, Lilian, Peters, Donald, & Stein, Nancy. Observing behavior in kindergarten and preschool classes. Childhood Education, February, 1968, 44 (6), 400-405.

Lumsdaine, A. A. Educational technology, programmed learning, and instructional sciences. In E. R. Hilgard (Ed.), Theories of learning and instruction. Chicago: University of Chicago Press, 1964.

National Conference on Needed Research in Mathematics Education. Journal of Research and Development in Education, Fall, 1967, 1 (1).

Sears, Pauline. The effect of classroom conditions on the strength of achievement motive and work output of elementary school children. Stanford University: Cooperative Research Project No. OE873, 1963.

Suppes, Patrick, Atkinson, Richard, et. al. Progress report in computer assisted instruction for the period October 1, 1967, to December 31, 1967.

Suppes, Patrick. Some theoretical models for mathematics learning. Journal of Research and Development in Education, 1967, 1, 5-23.

Suppes, Patrick. Personal communication. 1968.

Wodtke, K. H. , Mitzel, H. E.& Brown, B. R. Some preliminary results on the reactions of students to computer assisted instruction. Proceedings of the 73rd Annual Convention, American Psychological Association, 1965, 329-330.

Table 1

Factor Loadings of Behavior Scores Employed in the Definition of 4 Factors, N = 72, (combined CAI and non-CAI Groups [xx]

Academic Behavior, Spring (accounts for 18% of variance)	
Cognitive behavior, Spring	.85
Task orientation, Spring	.78
Satisfaction, Spring	.62
Achievement motivation, Spring	.56
Academic Behavior, Fall (accounts for 10% of variance)	
Cognitive behavior, Fall	.80
Satisfaction, Fall	.67
Task orientation, Fall	.62
Achievement motivation, Fall	.35
Social Behavior, Spring (accounts for 14% of variance)	
Social total[x], Spring	.89
Social motivation, Spring	.89
Satisfaction, Spring	.33
Achievement motivation, Spring	-.34
Social Behavior, Fall (accounts for 12% of variance)	
Social motivation, Fall	.87
Social total, Fall	.86
Task orientation, Fall	-.32
Achievement motivation, Fall	-.33

Smaller factors (not included in Table 1) were labelled: (1) Compliance motivation, Spring (9% of variance), (2) Motility, Fall-Spring (8% of variance), and (3) Compliant non-achievement, Fall (6% of variance).

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[x] Social total is a composite of the following behavior categories: Social work + Social motivation + child and teacher interaction + child initiates interaction with teacher.

[xx] Standard error is about .25. Therefore, a loading of approximately .5 is considered significant. Other loadings are included for purposes of defining the factors.

Table 2

Correlations between Fall and Spring Behavior Factors [xxx]

	Academic Behavior	Social Behavior
All CAI Subjects (N = 45)	.26	.36[x]
All non-CAI Subjects (N = 27)	.65[xx]	.20
CAI Math Instruction Subjects (N = 22)	.02	.43[x]
CAI Reading Instruction Subjects (N = 23)	.50[x]	.29

x < .05 level of significance

xx < .01 level of significance

xxx All are two-tailed tests of the statistical significance of a correlation coefficient.

Table 3

Four 2x2 Analyses of Variance
Group Differences in Means for CAI and non-CAI Children, Boys and Girls, and Interactions on Each of the Four Behavior Factor Scores [x]

	Factor 1		Factor 2		Factor 3		Factor 4	
	Academic, Spring		Social, Spring		Social, Fall		Academic, Fall	
	Mean	SS	Mean	SS	Mean	SS	Mean	SS
CAI Boys	.0	16.1	-.5	22.5	.5	104.7	.0	10.5
CAI Girls	.1	10.3	-.1	47.1	.7	51.3	.0	5.0
Non-CAI Boys	-.2	12.7	.5	45.0	-1.0	79.1	.1	2.9
Non-CAI Girls	-.0	10.4	.5	37.9	-1.1	78.8	.1	5.7
	t	Signif. Level	t	Signif. Level	t	Signif. Level	t	Signif. Level
Sex	.7	NS[xx]	.4	NS	.1	NS	.2	NS
Treatment	.6	NS	2.2	<.05	2.3	<.05	.7	NS
Interaction	.3	NS	.4	NS	.1	NS	.7	NS

x Mean for each factor = 0.0, standard deviation = unity by definition.

xx All are two-tailed tests of significance.

Table 4

Correlations of Fall and Spring Behavior with IQ and Achievement for CAI versus non-CAI Children

	All CAI (N = 45)				Non-CAI (N = 27)			
	Academic Behavior		Social Behavior		Academic Behavior		Social Behavior	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
1. IQ[1]	-.13	.51^{xx}	.18	-.28^{x}	--	--	--	--
2. Math Achievement[2]	.03	.58^{xx}	-.24	-.43^{xx}	--	--	--	--
3. Reading Achievement	.01	.26	-.07	-.06	.01	-.22	-.13	.07
4. Reading Level	.16	.42^{xx}	-.17	-.33^{x}	-.14	-.14	-.13	.14
5. Computer Progress	.17	.32^{x}	-.27	-.43^{xx}	--	--	--	--

x < .05 level of significance

xx < .01 level of significance

1 IQ data unavailable for non-CAI children

2 Math achievement data unavailable for non-CAI children

Table 5

Correlations of Fall and Spring Behavior with IQ and Achievement for CAI Reading versus CAI Math Children

	CAI Reading Group (N = 23)				CAI Math Group (N = 22)			
	Academic Behavior		Social Behavior		Academic Behavior		Social Behavior	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
1. IQ Stanford Binet	-.02	.29	.35	-.45^{x}	-.23	.71^{xx}	.07	-.09
2. Math Achievement Stanford	.35	.51^{x}	-.34	-.58^{xx}	-.34	.64^{xx}	-.13	-.22
3. Reading Achievement California	.23	.05	-.28	-.32	-.12	.55^{xx}	-.04	.11
4. Reading Level Teacher judgment	.36	.29	-.24	-.43^{x}	-.25	.66^{xx}	-.04	-.01
5. Computer Progress Total lessons in own subject matter	.38	.23	-.50^{x}	-.44^{x}	-.02	.46^{x}	-.33	-.19

x < .05 level of significance

xx < .01 level of significance

Table 6

Partial Correlations Between Academic Spring Behavior and Achievement with IQ (Stanford-Binet) Removed

	CAI Reading (N = 23)	CAI Math N = 22)
1. Academic, Spring with Stanford Math Achievement Test	.51 xx	.64 xx
2. With IQ removed	.38 x	.11
3. Academic, Spring with Reading level	.29	.66 xx
4. With IQ removed	.18	.34 x
5. Academic, Spring with California (Reading) Achievement	.05	.55 xx
6. With IQ removed	.00	.18
7. Academic, Spring with Computer Progress (total lessons done)	.23	.46 x
8. With IQ removed	.13	.14

x < .05 level of significance.
xx < .01 level of significance.

Appendix A

Loadings of 18 Behaviors on the First Four Factors Extracted by a Principal Components Factor Analysis

Behaviors	Factor 1 Academic Spring	Factor 2 Social Spring	Factor 3 Social Fall	Factor 4 Academic Fall
Cognitive Behavior Spring	.85	-.20	-.05	.19
Task Orientation Spring	.78	-.24	.11	.12
Satisfaction, Spring	.62	.33	-.09	.07
Achievement Motivation Spring	.56	-.34	-.16	.04
Sensory Motor Motivation Fall	.32	.42	.17	-.05
Social Total, Spring	-.06	.89	.00	.10
Social Motivation, Spring	-.27	.86	-.04	.06
Social Motivation, Fall	.08	.04	.87	.07
Social Total, Fall	-.09	-.05	.86	.05
Cognitive Behavior, Fall	.09	.00	.05	.80
Task Orientation, Fall	.28	.03	-.32	.62
Achievement Motivation, Fall	-.26	-.38	-.33	.35
Satisfaction, Fall	.03	.28	.07	.67
Sensory Motor Motivation, Spring	-.04	.05	.02	-.06
Motility, Fall	-.05	-.04	.01	-.08
Motility, Spring	-.05	-.04	.01	-.08
Compliance, Fall	.10	.05	-.15	.07
Compliance, Spring	.01	-.07	-.02	.01

Appendix B

Correlations of Single Categories of Behavior at Two Different Points of Time

Behaviors (over time)	Correlation
SO_2 - SO_3 *	.04
TO_2 - TO_3	.20
SM_2 - SM_3	.10
AM_2 - AM_3	.03
CM_2 - CM_3	.04
SOM_2 - SOM_3	-.02
SA_2 - SA_3	.22
CO_2 - CO_3	.16
MO_2 - MO_3	$.36^{x}$

Correlations of Selected Pairs of Behavior Categories During the Same Time Period

Behaviors (same time)	Correlation
SO_2 - SOM_2	$.57^{xx}$
SO_3 - SOM_3	$.80^{xx}$
TO_2 - SA_2	$.40^{xx}$
TO_3 - AM_3	$.41^{xx}$
SM_2 - SO_2	$.57^{xx}$
SM_3 - AM_3	$-.35^{x}$
AM_2 - CM_2	$-.44^{x}$
AM_3 - TO_3	$.41^{xx}$
CM_2 - SOM_2	$-.31^{x}$
CM_3 - AM_3	$-.54^{xx}$
SOM_2 - TO_2	$-.30^{x}$
SOM_3 - SO_3	$.80^{xx}$
SA_2 - TO_2	$.40^{xx}$
SA_3 - MO_3	$.35^{x}$
CO_2 - SA_2	$.56^{xx}$
CO_3 - TO_3	$.56^{xx}$
MO_2 - SM_2	.27
MO_3 - SA_3	$.35^{x}$

x < .01 level of significance

xx < .05 level of significance

* Subscript 2 means a Fall measure, 3 means a Spring measure; SO--Social Behavior, TO--Task Orientation, AM--Achievement Motivation, SM--Sensory Motor Motivation, CM--Compliance Motivation, SOM--Social Motivation, SA--Satisfaction, CO--Cognitive, MO--Motility.